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ABSTRACT

Five university faculty members identified six broad topic areas in research and statistics that they considered important for Master's level graduate students. The six areas were: (1) types of research; (2) research process; (3) hypothesis testing; (4) data gathering; (5) descriptive statistics; and (6) inferential statistics. These broad areas were further defined by 31 more specific topics. Test items were developed and administered to graduate students in introductory research methods courses. One sample of 124 students served as the development sample and the other sample of 85 students served as the research sample. It was found that, after taking an introductory research methods course, Master's students were generally prepared to critique research but not to conduct independent, original research. (Contains 1 table and 10 references.) (Author/SLD)

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Competencies in graduate education: What should students know about research and statistics?

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Abstract

University faculty identified six broad topic areas in research and statistics that they considered important for master's level graduate students. These broad areas were further defined by 31 more specific topics. Test items were developed and administered to graduate students in introductory research methods courses. We found that, after taking an introductory research methods course, master's students were generally prepared to critique research but not to conduct independent, original research.

Competencies in graduate education: What should students know about research and statistics?

What should master's level graduate students in colleges of education know in the area of research and statistics? Many graduate students pursuing a master's degree are required, or make the choice, to write a thesis. Others are required to produce a document that demonstrates their skills in synthesizing research on a suitable topic that applies to their particular field. Still others are asked to convince a faculty committee that they understand research and statistics as they apply to their field by performing on written and oral comprehensive examinations. Are students adequately prepared in their programs of study to meet these outcomes? The purpose of this study was to identify those research skills that are considered important by the teaching faculty and to assess the degree to which students in master's programs in education are acquiring those skills as a result of coursework.

This is the initial phase in a larger study in which our ultimate goal is to provide some standards in the area of research and statistics for colleges of education. Our vision is that faculty in colleges of education can reach consensus regarding the skills in research and statistics desired as outcomes in graduate students.

Literature Review

Skills needed for research

Graduate students pursuing master's degrees are expected to develop skills that will enable them to critically read and evaluate research and to

identify suitable research problems. Students who pursue a thesis option must be able to design and conduct a study and to analyze and interpret their findings. In addition, whether or not they plan to write a thesis, they must be able to communicate their findings to an audience who will, in turn, critically evaluate their work. The complete research processes involved in scholarly research activities include both technical skills, such as organizing literature searches and writing in a scholarly fashion, and critical thinking skills, such as proposing thoughtful and appropriate hypotheses based on and extending an existing knowledge base. According to Ary, Jacobs, and Razavieh (1996), desired competencies for beginning researchers include developing viable research problems; understanding the role of previous research and theory; using sampling procedures, statistics, and measurement that are appropriate for selected research problems; recognizing the advantages and disadvantages of differing approaches to research; interpreting research findings; and preparing a final report in a scholarly format. Although all graduate students may not be required to conduct original research, at the very least they will certainly be expected to evaluate the research of others'.

Student preparation

Master's level graduate students often take a single introductory research methods course to meet the requirements for their degree (Doak, 1982).

Given that the course may be the student's only training in research and statistics, teaching faculty are relied upon to deliver a comprehensive and important curriculum. They must communicate the broad spectrum of

research in an educational setting, as well as impart sufficient specific knowledge that students will need to conduct research independently. Surveys have assessed the effectiveness of this course and found the course generally useful in providing students with basic skills such as evaluating research and understanding terminology (Todd & Reece, 1987). However, other studies have shown that both graduate students and faculty question the adequacy of the preparation students receive from such a course, especially if the course is to serve as motivation for conducting independent research (Monahan, 1994). Sipe and Doherty (1993) found, in a case study where graduate students conducted real research in a community setting, that the traditional training graduate students receive is not adequate in preparing them to engage in meaningful research. Indeed, it appears to benefit students a great deal if they are involved in other research activities, such as mentoring by faculty, conference presentations, collaboration with other students in research teams, and the like (Ertmer, Provo. Moreno, Butcher, Leuck, MacDougall, Newby, 1996; Green & Kvidahl, 1990). However, our study examined only the benefits students gained from a single introductory research and statistics course.

Need for standards

Is it important to establish competencies in research and statistics for graduate students? Professionals in education-related associations agree on the importance of competencies, or standards, and encourage their development. For example, The American Federation of Teachers, the

National Council on Measurement in Education, and the National Education Association developed a document titled "Standards for Teacher Competence in Educational Assessment of Students" (1990). These associations were committed to the ideal that assessment is an integral part of good teaching and that creating standards would serve as a guide in teacher preparation programs. In their document they define a standard as "a principle generally accepted by the professional associations responsible for the document." The National Council of Teachers of Mathematics developed (1989), and is in the process of revising, their standards for the teaching of mathematics in much the same way. In the field of educational research, the American Educational Research Association (1991) proposed a set of ethical standards to serve as a guide in the consideration and treatment of human subjects. However, standards for the content and mastery of outcomes in research and statistics in graduate programs have not yet been proposed.

Method

Data were collected from faculty and graduate students associated with colleges of education in two universities located in the western United States. Faculty were those involved in teaching research and statistics methods courses at the graduate level. Graduate students were enrolled in master's programs in education and were taking an introductory research methods course. The research methods courses were considered by the teaching faculty to be very similar in content at the two universities.

The teaching faculty ($n=5$) collaborated on identifying six broad topical areas in research and statistics that they determined should be addressed in developing outcomes of a master's program in a college of education. The six areas were: types of research, research process, hypothesis testing, data gathering, descriptive statistics, and inferential statistics. The six broad areas were further defined by 31 underlying topics. Based on the 31 topic areas, they designed three test items for each topic to assess student mastery. For example, the following three test items were designed to assess an understanding of sampling:

(Item #1) A researcher plans to conduct a poll by sampling fans from the population of all fans of the Rockies. She selects her sample by stopping people as they leave the stadium upon completion of a game. The type of sampling she used is

- a. systematic
- b. stratified
- c. convenience
- d. random

(Item #2) A sample is considered random if

- a. every subgroup in the population is included
- b. every element in the population has an equal and independent chance of being included
- c. an infinite number of subjects is available for sampling
- d. the sample is known to well represent the population

(Item #3) In doing a survey of Chicago residents' evaluation of their schools, the researcher divided the city into 9-square-block areas and randomly selected 20 areas for his study. This is an example of:

- a. stratified sampling
- b. cluster sampling
- c. subgroup analysis
- d. use of a large sample

Two samples of students in introductory research methods classes were selected; one was used as the development sample ($n=124$) and the second as a research sample ($n=85$). A total of six classes were used in the study. One class being used as part of the development sample was tested at the beginning of the semester and two other classes were tested at midterm and at the end of the semester. The three classes forming the research sample were tested at midterm and at the end of the semester. The 93 test items were administered to the development sample and were subjected to item analysis; items were revised and administered to the research sample. The degree to which students mastered the competencies was assessed using the results from the research sample. Mastery was considered achieved for students who had correct answers on two of the three items for each of the 31 topics.

Results

The areas of mastery were primarily within the broad areas related to research design and process. Most topics not mastered by the students were within the general areas of descriptive statistics, data gathering, hypothesis testing, and inferential statistics. Table 1 illustrates the percent of students who mastered each of the 31 topics. Average mastery for each broad area was also calculated. On average, 87% of the students mastered research processes and 82% mastered research designs. However, in the other four broad areas, student competency was much less impressive. Students averaged 70% mastery on descriptive statistics, 61% succeeded in data gathering topics, 58%

mastered hypothesis testing items, and only 38% mastery was demonstrated in the inferential statistics area. Our findings indicated that most graduate students participating in this study, on average, did not master all of the necessary competencies to conduct independent, original research.

Discussion and Conclusion

The teaching faculty for research methods and statistics courses identified 31 topic areas as the essential knowledge base for master's level graduate students to acquire. The introductory research methods course that was required for master's students addressed each topic, although some topics received limited attention due to the extensive nature of the course content. Based on the results of this study, most students whose only training in research and statistics comes from this introductory course are possibly sufficiently trained to read and critically evaluate research in their fields, although these students would likely have difficulty interpreting a statistical analysis. Additionally, after completing an introductory research methods course, most students are ill-prepared to design, conduct, analyze, interpret, and write a report of a study. A traditional master's program requiring only one research course does not provide students with the opportunity to develop the needed skills so that they can participate, in a scholarly fashion, in activities related to research.

In our ongoing research program, we will continue to assess graduate students' research skills. We will assess students' skills at varying stages of their scholarly development, in hopes that they will have the opportunity to

become involved in other research activities or take additional research and statistics courses. We will continue to work with teaching faculty in research and statistics courses to develop items to assess topic mastery; these items may be used for students to demonstrate their knowledge without taking the traditional research course. Also, from our topic list, we will work with faculty to develop a broad set of questions useful for written and oral comprehensive examinations. Our goal is to offer a set of standards to other professionals in the field for their reactions. Ultimately we hope to be able to communicate precisely and thoroughly the research and statistics competencies expected of graduate students by their faculty.

Table 1

Topic Area Mastery

Research Topic Areas	Percent Mastering
I. Research design	82%
II. Research process	87%
Formulation of viable research problems and hypotheses	91%
Scientific method	94%
Literature sources and searching	89%
Types of variables	84%
Types of sampling	82%
Ethical, legal, treatment of human subjects	90%
Internal and external validity of designs	79%
III. Hypothesis testing	58%
Significance level, p-value, power	46%
Errors	42%
Null and alternative hypotheses	79%
Interpretation of results, statistical significance	66%
IV. Data gathering	61%
Measurement	59%
Reliability estimates	51%
Validity estimates	48%
Standard error	32%
Conducting surveys and interviews	81%
Rating scales	75%
Likert scales	79%
V. Descriptive statistics	70%
Dataset organization	58%
Measures of center	89%
Measures of dispersion	70%
Standard scores	88%
Contingency tables, chi-square	61%
Correlation coefficients	48%
Distributions	74%
VI. Inferential statistics	38%
Elements of probability	64%
Sampling distributions	42%
Sampling error	39%
Common hypothesis testing procedures	23%
Interpreting computer printouts	24%

Note: Average percents for the six broad areas are in bold type. $n=85$.

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